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ABSTRACT

Reported are three studies investigating the mental abilities of children and adolescents. The first study (by Chamnong Vibulsri) had three purposes: (1) to determine whether and how language affects logical thinking in Thai children; (2) to ascertain whether Piaget's or Bruner's theory would more accurately explain any such relationship; and (3) to search for additional findings relevant to the context of teaching and learning. Findings indicated that, while verbal language had no better effect than non-verbal language, language definitely did have an impact on Thai children's logical thinking, suggested that young children might most effectively be taught conservation of substance audio-visually, and advised an integration of theories. The second study (by Seng Seok Hoon, Singapore) examined individual and additive effects of task manipulations on class inclusion performance by 128 boys and girls between the ages of 6 and 8 years. While results indicated a lack of additive effect, comparisons of single task manipulations suggested that referencing a common superordinate cue or adding an inclusive verbal cue in the class inclusion question facilitated class inclusion performance. The third study (by Chumporn Yongkittikal of Thailand) dealt with culture-fair tests. Raven's Standard Progressive Matrices, Cattell's Culture Fair Intelligence Scale 3, Form B, and Dominoes 48 Tests were administered to 3,569 Thai boys and girls who were attending 16 government and private schools and who ranged in age from 12 to 18 years. The purpose of the study was to investigate the tests' developmental properties, examine item statistics, assess reliability and validity, and establish norms of the test scores for Thai adolescents. The third paper is presented in abstract form; the full paper may be obtained from the editors of the conference. (RH)

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SYMPOSIUM I B: Mental Abilities of Children and Adolescents

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The Impact of Language on Logical Thinking in Thai Children: an Experimental Research*

Chamnong Vibulsri

INTRODUCTION

The attempts to understand the impact of language on logical thinking frequently lead researchers to an examination of problem-solving behaviour in young children. This examination is due to a basic asumption that the child is indeed 'father of the man'.[1] Hilgard and his associate further state that 'We can understand much of adult behaviour only through a knowledge of the cause of its development in the child'.[2]

Historically, the relationship between language and logical thinking was proposed as a study in the eighteenth century by Johann Herder.[3] Since the early nineteenth century, however, the area of language-thought relationship has been of interest to scholars in various academic disciplines.[4] Von Humboldt looked at language as a tool used by human beings to represent ideas for their communicative purposes.[5] Sapir and Whorf advocated that our logical thinking is dependent upon our language.[6] Carroll postulates that 'thought and cognition are presupposed by language'.[7] Cherry suggests that language is dominant over thought.[8] Dance and Larson imply that language can help children develop their logical thinking, particularly for problem-solving purposes.[9]

Similarly, when dealing specifically with young children (5, 6 and 7 year olds), Bruner agrees that language can facilitate their logical thinking in solving problems.[10] Piaget disagrees with Bruner concerning the explanation of the language-thought relationship in young children. Piaget

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contends that the structures which characterise thought have their roots in action and in sensori-motor mechanisms that are deeper than language.[11]

Based on the differing viewpoints of Piaget and Bruner, this research was conducted in an attempt to obtain further empirical support for either position. This study dealt specifically with Thai children aged 5-7 years old. According to Piaget's theory, the children in this study were in a transition period betweer. the 'pre-operational' and 'concrete operational' stages. Consequently, only problems of 'conservation of substance' were used to investigate the impact of language on logical thinking in Thai children. This limitation was based on Piaget's finding that in young children, conservation of substance develops before conservation of weight and conservation of volume respectively.[12]

The major purposes of this study were: (a) to test whether and how language affects logical thinking in Thai children (b) to ascertain which theory, Piaget's and Bruner's, would explain more accurately the relationship between language and logical thinking in Thai children and (c) to search for any additional evidence relevant to Thai children's logical thinking process in order to apply it properly to both teaching and learning activities.

The three hypotheses tested in this research were:

H_1: Children exposed to pictures on a videotape with verbal explanation of conservation principles will perform significantly better on the conservation test than those children exposed to the same pictures on a videotape without verbal explanation (P + VE) > (P).

H_2: Children exposed to the recorded verbal explanation without seeing any illustrative pictures on the videotape will perform significantly better than children exposed only to the illustrative pictures on the videotape without hearing any verbal explanation of the same conservation principles (VE) > (P).

H_3: There will be no significant difference in conservation between children exposed *only* to the recorded verbal explanation and children exposed simultaneously to *both* the recorded verbal explanation and illustrative pictures (VE) = (P + VE).

These three hypotheses are interrelated and they can be precisely stated as: (VE) = (P + VE) > (P).

METHODS

This experiment was a continuation of my previous study conducted with American children as subjects.[13] The research paradigm was a 3 x 3 factorial design. The two major independent variables were: (1) age of the sample with three different levels: 5, 6 and 7 year old (2) videotaping and

recording information presented to the children in three different conditions: (a) nonverbal language or pictures only (P) (b) verbal language or verbal explanation only (VE) and (c) a combination of both nonverbal and verbal languages (P + VE). The children were randomly assigned to one of these three conditions. Three dependent variables were used, namely three sets of children's scores earned on a selection test and two achievement tests.

Subjects

A total of 153 Thai children identified by the selection test as 'nonconservers' were selected for the sample in this study. The sample was drawn from a list of school children in Bangkok, Thailand, whose ages were 5, 6 and 7 years. The 5, 6 and 7 year old children were used as the sample because of the assumption that at these age levels, children did not seem to demonstrate consistently true conservation behaviour.[14] Of all the nonconservers selected for the sample, there were 51 children for each age group (17 children for each condition).

Materials/Equipment

The following materials and equipment were used in this study:

(1) A set of coloured National portable videotape recorder to present information of conservation principles to children.
(2) Two cassette tape recorders and their audio cassette tapes for recording and replaying the recorded data.
(3) Four beakers for containing liquid substance: two of them were identical in size (150 milliliters for each), another was larger (400 milliliters in size) and the other was the largest (1,000 milliliters).
(4) Six alternative sets of wire coils, 1½ inches in diameter with three loops for each. Only one set of them was used at a time for determining each child's achievement of conservation of wire. To test the conservation, the shape of wire coil was stretched to form a spiral.
(5) Soft drink (Fanta) was shown on the videotape to demonstrate conservation principles to nonconservers after the selection and before the achievement tests.
(6) Water was used to test each child's achievement of conservation of liquid substance. It was poured first from the largest beaker into two identical containers until it reached the same level. The shape of the water was then altered by pouring it into a container of a different diameter.
(7) A set of four clay balls, the first two balls were identical in size (1 inch in diameter for each); of the remaining two, one ball was 2/3 inch in diameter. To test the conservation of clay, one of the identical clay balls was modified by elongating it like a sausage.

Procedure

Three separate sets of conservation tests were prepared and administered individually. One set was the selection test, containing questions dealing specifically with the conservation of wire; the other two sets were the achievement tests, containing questions dealing specifically with the conservation of water and clay. All tests were administered in Thai in a type of 'interviewing' situation, similar to those used by Piaget and Inhelder.[15] The testing materials for each test were presented in two major directions (a) two identical objects were lined up in a direction called 'parallel dimension' (i.e. the direction which was parallel to the chests of the interviewer and the child) (b) the two identical objects were shown first in a 'parallel dimension', and then one of them was transformed by placing it in a new direction called 'perpendicular dimension' (i.e. the direction which was perpendicular to the interviewer and the child).

The selection test was given to children before they were exposed to any conditions. By contrast, the achievement tests were given to children immediately after they were exposed to one of the three conditions: P, VE or P + VE. All responses made by children from each test were tape recorded for determining the 'interjudge reliability.'

Scoring and Reliability

Children's performances on each conservation test were graded on a 3 point scale: '0' = fail, '1' = intermediate, and '2' = pass. The scoring was done separately by three independent judges for each test in order to obtain 'interjudge reliability' of the test scores. The interjudge reliability for the selection test was 100% agreement but the average interjudge reliability for each achievement test was 97.39%.

Data Analyses

Children's test scores were computed as frequency data, ordinal scale data and interval scale data. The major statistical tests used were the arithmetic mean, the chi square, the *t* test, the two-way analysis of variance and the Pearson *r*. All test results were computed and analysed through both computer processing and content analysis procedure.

RESULTS

General Findings

(1) Age. For conservation of water, the x^2 analysis (shown in Table 1) indicated no significant differences among the groups of 5, 6 and 7 year olds, $x^2(4) = 7.43$, $P < .1149$. Analysis of variance (presented in Table 2) provided the same finding, $F(2, 144) = 2.40$. $P < .10$.

Table 1
Conservation of Water:
Frequency of Children's Scores Classified by Age

Scores	Age/Year 5	6	7	Row Total
0	32	29	30	91
1	11	6	4	21
2	8	16	17	41
Column Total	51	51	51	153

x^2 (4) = 7.43, $P < .1149$.

Table 2
Conservation of Water:
Analysis of Variance for Children's Scores Classified by Age and Condition

Source	Sum of Squares	df	Mean Square	F
Age	1.58	2	0.79	2.40
Condition	62.52	2	31.26	94.71**
Age x Condition	4.03	4	1.01	3.05*
Residual	47.55	144	0.33	

** $p < .01$
* $p < .02$

Similarly, for conservation of clay, the x^2 analysis (shown in Table 3) indicated no significant differences among the three age levels, $x^2(4) = 2.50$, $p < .6439$. Analysis of variance (Table 4) revealed the same effect, $F(2, 144) = 1.65$, $p < .10$ (Tables 3 and 4).

Table 3
Conservation of Clay:
Frequency of Children's Scores Classified by Age

Scores	Age/Year 5	6	7	Row Total
0	36	33	30	99
1	5	4	4	13
2	10	14	17	41
Column Total	51	51	51	153

$x^2(4) = 2.50, p < .6439.$

Table 4
Conservation of Clay:
Analysis of Variance for Children's Scores Classified by Age and Condition

Source	Sum of Squares	df	Mean Square	F
Age	1.66	2	0.83	1.65
Condition	35.46	2	17.73	35.23**
Age x Condition	8.42	4	2.11	4.18*
Residual	72.47	144	0.50	

** $p < .0001$
* $p < .003$

(2) Condition. For conservation of water, the x^2 analysis (Table 5) indicated a significant difference among the three conditions, $x^2(4) = 87.85$ $p < .00001$. Analysis of variance (Table 2) resulted in the same outcome, $F(2, 144) = 94.71, p < .01$ (Tables 5 and 2 respectively).

Table 5
Conservation of Water:
Frequency of Children's Scores Classified by Condition

Scores	P	VE	P+VE	Row Total
0	47	40	4	91
1	2	5	14	21
2	2	6	33	41
Column Total	51	51	51	153

$x^2(4) = 87.85, p < .00001$

Similarly, for conservation of clay, the x^2 analysis (Table 6) revealed significant differences among the three conditions, $x^2(4) = 46.88, p < .00001$. Analysis of variance (Table 4) also revealed the same result, $F(2, 144) = 35.23, p < .00001$. (Tables 4 and 6).

Table 6
Conservation of Clay:
Frequency of Children's Scores Classified by Condition

Scores	P	VE	P+VE	Row Total
0	45	39	15	99
1	2	5	6	13
2	4	7	30	41
Column Total	51	51	51	153

$x^2(4) = 46.88, p < .00001.$

Testing of Hypotheses

Hypothesis 1: $(P + VE) > (P)$. For conservation of water, the x^2 result (Table 7) indicated a significant difference between the P + VE and the P conditions, $x^2(2) = 72.71, P < .00001$. The *t*-test result (Table 8) revealed the same outcome, t (100) = 13.42, $P < .00001$. Accordingly, hypothesis 1 was supported for water (Tables 7 and 8 respectively).

Table 7
Conservation of Water: Pairwise Comparisons by Using x^2 Based on Frequency of Children's Scores, Classified by Conditions

Scores	Conditions					
	P (n = 51)	VE (n = 51)	P (n = 51)	P + VE (n = 51)	VE (n = 51)	P + VE (n = 51)
0	47	40	47	4	40	4
1	2	5	2	14	5	14
2	2	6	2	33	6	33
x^2 (df = 2)	3.85 p < .1460		72.71 P < .00001		52.41 P < .00001	

Table 8
Conservation of Water: Pairwise Comparisons by Using *t*-test Based on Children's Mean Scores, Classified by Conditions

Scores	Conditions					
	P (n = 51)	VE (n = 51)	P (n = 51)	P + VE (n = 51)	VE (n = 51)	P + VE (n = 51)
x	0.1176	0.3333	0.1176	1.5686	0.3333	1.5686
SD	0.431	0.683	0.431	0.640	0.683	0.640
x^2 (df = 100)	1.91 P < .059		13.42 P < .0001		9.42 P < .0001	

Similarly, for conservation of clay, the x^2 analysis (Table 9) revealed a significant difference between the P + VE and the P conditions, $x^2(2) = 36.88$, $p < .00001$. The *t*-test result (Table 10) showed the same outcome, t (100) = 7.37, $p < .0001$. Therefore, hypothesis 1 was also supported for clay (Tables 9 and 10 respectively).

Table 9
Conservation of Clay: Pairwise Comparisons by Using x^2 Based on Frequency of Children's Scores, Classified by Conditions

Scores	Conditions					
	P (n = 51)	VE (n = 51)	P (n = 51)	P + VE (n = 51)	VE (n = 51)	P + VE (n = 51)
	45	39	45	15	39	15
	2	5	2	6	5	6
	4	7	4	30	7	30
x^2	2.53		36.88		25.05	
(df = 100)	P < .2819		P < .00001		P < .00001	

Table 10
Conservation of Clay: Pairwise Comparisons by Using *t*-test Based on Children's Mean Scores, Classified by Conditions

Scores	Conditions					
	P (n = 51)	VE (n = 51)	P (n = 51)	P + VE (n = 51)	VE (n = 51)	P + VE (n = 51)
x^2	0.1961	0.3725	0.1961	1.2941	0.3725	1.2941
(df = 100)	0.566	0.720	0.566	0.901	0.720	0.901
t	1.38		7.37		5.71	
(Df-1000)	P < .172		P <0001		P < .0001	

Hypothesis 2: *(VE) > (P)*. For conservation of water, the x^2 analysis (Table 7) indicated no significant difference between the VE and the P conditions, $x^2(2) = 52.41$, $P < .00001$. The *t*-test result (Table 8) revealed the same outcome, $t(100) = 9.42$, $P < .0001$.

Similarly, the findings for conservation of clay (Table 9) indicated no significant difference between the VE and the P conditions, $x^2(2) = 2.53$, $P < .2819$. The *t*-test result (Table 10) showed the same effect, $t(100) = 1.38$, $P < .172$. Consequently, no support was found for the second hypothesis with regard to either conservation task.

Hypothesis 3: (VE) = (P + VE). For conservation of water, the x^2 analysis (reported in Table 7) indicated a significant difference between the P + VE and the VE conditions, $x^2(2) = 52.41$, $P < .00001$. The *t*-test result (presented in Table 8) revealed the same outcome, $t(100) = 9.42$, $P < .0001$.

For conservation of clay, the x^2 analysis (Table 9) indicated a significant difference between the P + VE and the VE conditions, $x^2(2) = 25.05$, $P < .00001$. The *t*-test result (Table 10) showed the same effect, $t(100) = 5.71$, $P < .0001$. Therefore, no support was found for the third hypothesis with regard to either conservation task.

These findings can be precisely re-stated as: (P + VE) > (P) = (VE). That is, there is no significant difference in performance between children exposed *only* to the illustrative pictures on the videotape and children exposed *only* to the recorded verbal explanation. This finding points to the fact that verbal language (VE) and nonverbal language (P) alone have no significant impact on logical thinking in children. By contrast, children exposed to pictures with verbal explanation (P + VE) will perform significantly better than children exposed to the same pictures without verbal explanation (P) and also better than children exposed only to the recorded verbal explanation without seeing any illustrative pictures (VE). This indicates the fact that the language in which both verbal and nonverbal aspects are combined definitely has a stronger impact on logical thinking in Thai children than either verbal or nonverbal language alone.

The results of this experimental research also revealed the following information:

(1) In general, there is no significant difference in conservation achievement of both water and clay among children aged 5, 6 and 7 years old except in the following cases:

There is a significant difference in performance between children aged 5 and 7 who were exposed to a combination of verbal and nonverbal languages (P + VE) regarding conservation of both water and clay.

There is a significant difference in performance between children aged 5 and 6 who were exposed to a combination of verbal and nonverbal language (P + VE) regarding conservation of water only.

There is a significant difference in performance between children aged 6 and 7 who were exposed to a combination of verbal and nonverbal languages (P + VE) regarding conservation of clay only.

These findings reveal that age alone has no impact upon logical thinking in Thai Children. However, if Thai children at different age levels are exposed to appropriate lanugage (i.e. the language in which both verbal and nonverbal aspects are combined) then they can use their logical thinking better in problem-solving. Therefore, it may be concluded that both age and conditions in which appropriate language is used are combining factors that have direct influence upon Thai children's logical thinking process.

By contrast, the use of inappropriate language in teaching children (e.g. using either verbal or nonverbal language alone instead of a combina-

tion of both) may result in the confusion of the older children. Hence, there was a tendency to show poorer performance than that of younger children as indicated in Tables 11 and 12.

Table 11
Conservation of Water: Children's Mean Scores Classified by Condition and Age

Age/Year	Condition			
	P (n = 51)	VE (n = 51)	P + VE (n = 51)	Total (n = 153)
5	0.1176	0.3529	1.1176	0.5294
6	0.1765	0.3529	1.7059	0.7451
7	0.0588	0.2941	1.8824	0.7451
Total	0.1176	0.3333	1.5686	0.6732

Table 12
Conservation of Clay: Children's Mean Scores Classified by Condition and Age

Age/Year	Condition			
	P (n = 51)	VE (n = 51)	P + VE (n = 51)	Total (n = 51)
5	0.2353	0.3529	0.8824	0.4902
6	0.2941	0.4706	1.1176	0.6275
7	0.0588	0.2941	1.8824	0.7451
Total	0.1961	0.3725	1.2941	0.6209

(2) In answering questions which require logical thinking about conservation of water, the most common reasons in order of frequency were identity', 'compensation', 'reality' and 'reversibility'. This suggests that in helping Thai children develop a proper logical thinking process concerning conservation of liquid substance, the teacher should begin by stressing the 'identity' aspect first, 'reality' and then 'reversibility'.

(3) In answering questions which require logical thinking about conservation of clay, the most common reasons were the order of 'compensation', 'identity', 'reality' and 'reversibility'. This suggests that in helping Thai children develop a proper logical thinking process concerning conservation of such substance as clay, the teacher should begin by stressing

the 'compensation' aspect first, then followed by the rest. (The findings in (2) and (3) also indicated that in teaching Thai children to solve different problems logically, the teacher should apply different methods. However, these methods of teaching must be in line with the children's tendency to understand each logical principle involved).

(4) The majority of children who gave inappropriate reasonings about conservation of water emphasized such dimensions as 'height', 'width' or 'depth', respectively. This finding supports Piaget's theory[16] that when answering questions on conservation of substance, children tend to stress the only dimension of the object as they see it.

(5) The majority of children who gave inappropriate reasonings about conservation of clay emphasised such dimensions as 'length, or 'width' or 'thickness'. This finding also supports Piaget's theory.

(6) The comparison between Thai children and American children revealed the following findings. As for Thai children, the difference in experimental conditions resulted in a significant difference in logical thinking for both conservation tasks. By contrast, when assigned to different experimental conditions there was a significant difference in logical thinking of American children for only conservation of water. The evidence affirmed that different methods of teaching are preferably required in order to teach Thai children effectively as opposed to American children. Consequently, Thai educators and teachers should not follow strictly the principles used by Americans in teaching young Thai children as it might not yield the same result. This finding, however, requires further review and in-depth investigation.

(7) In testing the performance of children on conservation of water and clay, it was found that the interaction between age and condition had no significant effect on the performance of American children. However, the same interaction showed a significant effect on the performance of Thai children. Therefore, in teaching Thai children, it is important to take into account both age level and the appropriate method of teaching for each age level. Otherwise the teaching may not achieve the desired result. This finding re-affirmed the necessity to review the present educational system in Thailand, especially at the levels of pre-school and elementary school.

DISCUSSION AND IMPLICATIONS OF MAJOR FINDINGS

Effects of Language

Concerning the effects of language, the results from testing all hypotheses suggested that the language in combination with both verbal and nonverbal aspects had a stronger impact on logical thinking of Thai children than either verbal or nonverbal language alone. Besides, it was discovered that verbal language alone had no better effect than nonverbal language. However, these findings pointed out that language defi-

nitely has an impact on logical thinking of Thai children. However, it must be the language in which both verbal and nonverbal aspects are combined and communicated appropriately for each age level. Generally speaking, this finding is congruent with Berlo's theory that states that 'We know that two channels are usually better than one, that a receiver will be more likely to decode a message accurately if he can see it and hear it at the same time.'[17]

Awareness of this finding may be helpful for elementary school teachers and curriculum planners to select teaching stimuli properly and to plan effective classroom activities, especially for young children. It suggested that the most effective method of teaching 'conservation of substance' to young children is the 'audio-visual approach'.

Effect of Age.

Regarding the effects of age, the results of this study revealed that there was no significant difference in the logical thinking patterns of Thai children at different age levels. This finding tends to be incongruent with Piaget's theory which maintains that age is an important factor for young children's achievement of conservation. However, in order to substantiate Piaget's contention on this particular aspect, further research to follow up this study is needed.

Furthermore, a comparative study between Thai children and American children showed that Thai children's achievement of conservation of water did not differ from conservation of clay, even if the age levels were different. By contrast, American children showed significant distinction in their conservation achievement at different age levels. From these findings, the following presumptions can be drawn:

(1) The development of Thai children in relation to conservation tas tasks may be slower than that of American children.
(2) Differences in environmental conditions, methods of child rearing and educational system, etc. may have direct influence upon logical thinking process of Thai children.

These findings implied that Thai educators and teachers should not follow strictly the American experts' models in teaching young Thai children since the evidence affirmed that the development of logical thinking in Thai children is remarkably different from that of American children.

The Piaget-Bruner Controversy

The evidence obtained from the study of Thai children did not support Piaget's theory with regard to the following argument: 'age or development of 'operational structures' are major factors in the achievement of conservations'. This conflicting point can be explained. First, the develop-

ment of Thai children may be slower than that of American children by nature. Thus, if the age level of the children is further extended, differences resulting from age may occur. Second, besides age, language is another factor. The evidence obtained from this study clearly indicated that if the language, in which both verbal and nonverbal aspects are combined, is used in explaining conservation principles to children, these children can develop a proper logical thinking process in solving conservation problems. Experiments done by Paris and Mahoney,[18] Sullivan, [19] and Sullivan and Waghorn[20] also produced the same results. This finding leads one to think that special training techniques may enable the children to develop their logical thinking, regardless of age. Based on the empirical evidence obtained in the present study, Piaget's theory may need revision in certain aspects.

With regard to Bruner's theory, the findings in general partially supported Bruner when he contends that language can facilitate young children's solving of conservation problems. However, Bruner seems to overemphasise the significance of language and pay no attention to other factors which may contribute to the logical thinking process of the children. In brief, both Piaget's and Bruner's theories need to be integrated to become an accurate theory, as suggested by Steiner,[21] Peill,[22] and Fischer.[23]

In answering the question posed at the beginning of this study 'Between Piaget's and Bruner's theories, which theory would explain more accurately the relationship between language and logical thinking in Thai children?' It could be concluded that Bruner's theory seemed to be more congruent with the process of logical thinking in Thai children than that of Piaget's theory. Unfortunately, neither theory is totally accurate. The overall results suggest integration of the two theories.

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12. J. Piaget and B. Inhelder, *Le developpement des quantites physique chez Penfant*, Neuchatel, Delachaux et Niestle, 1941, 1961. 'Conservation of substance' refers to the principle that a given amount of substance remains constant even though its shape or distribution is altered. The term 'language' refers to both verbal and non-verbal aspects. 'Verbal language' refers to the total 'Verbal explanation' given in that of the principle of conservation of substance through the videotape recorder to the sample; whereas 'nonverbal language' refers to the total 'pictures' shown from the same videotape recorder for the same purpose as that of verbal language.
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Facilitating Class Inclusion Performance in Young Children

Seng Seok Hoon

INTRODUCTION

A major issue in the recent research literature on children's cognitive development has been the degree which young children's logical competence has been underestimated. For example, Gelman (1978) has observed that by using the same procedures to administer the same tasks' to children of widely differing ages, we tend to treat the young child's processing capacity as similar to that possessed by the older child. Siegel (1978) found that many children who fail to demonstrate proficiency on traditional cognitive tasks nevertheless are capable of responding correctly to less verbal tasks which require the same logical abilities. Carmi (1981) argues that the life experiences of children provide them, at a very young age, with some sense of many concepts and reasoning patterns. However, if the cognitive tasks used to assess performance are incongruent with everyday experiences, then these tasks do not make sense to the young child. Donaldson (1978) believes that this is often the case and the child misinterprets the task. Consequently, such tasks typically underestimate the cognitive abilities of young children.

The structure of the task used to assess the young child's logical competence is a major factor contributing to the underestimation of that competence. Researchers have discovered that the requirements for successful performance on a given task affect the judgment of the competence assessed. When task requirements are changed, the performance of the young child changes. For example, contextual task requirements and procedural modifications have significantly altered performance in

spatial perspective-taking (Hirata, 1982). Procedural changes in Piaget's conservation tasks have also led to marked changes in performance.

In order to study closely the conditions under which competence is being demonstrated, the relationship between task requirements and performance must be much more carefully examined. This will clarify the distinction between *the competence inherent in the child and the performance* he demonstrates on a task.

The purpose of this study is to examine the relationship between task manipulations and the child's performance on a cognitive task. Specifically, it examines the effects of varying task structure on class inclusion performance. The research attempts to ascertain both the extent to which variation in class inclusion performance is influenced by different task manipulations and the extent to which these task variations are interactive in their effects. Based on theoretical and empirical considerations, a number of task manipulations will be selected to explore their individual and additive effects on class inclusion performance.

CLASS INCLUSION PERFORMANCE

The ability to classify has long been recognised as a critical aspect of cognition. From the time of Binet, questions involving classification have been found in intelligence tests. Tests of classification have been used to study flexibility of thinking. Classification is an important mental process in a young child's life as it involves the ability to sort or group a collection of objects according to a specified rule or in a systematic way. It is the child's way of making sense out of a complex world by reducing the number of pieces of environmental information with which he must deal.

Many kinds of classification behaviour have been investigated. Kofsky (1966) used a series of eleven classification problems to study the development of classification behaviour of children between ages of four and nine years. She found that class inclusion is the logical and critical end point in the development of young children's classification behaviour. Her results show that the acquisition of classification skills is gradual and requires a long period of time for its complete development. Children invariably pass all other classification tests before the class inclusion test.

Class inclusion ability has also been taken as a critical indicator of operativity within the Piagetian framework (Flavell, 1963; Inhelder and Piaget, 1964; Trabasso *et al.*, 1978). Primarily for these reasons, class inclusion performance has been studied more extensively than other types of classification behaviour. Though excellent comprehensive reviews of this research exist (Trabasso *et al.*, 1978; Winer, 1980), no research has been made to isolate the most potent task manipulations affecting class inclusion performance and to ascertain their joint effects.

A careful review was undertaken of the more than 60 class inclusion studies reported since 1964. Statistical significance, successful replication,

and lack of conflicting evidence were used as criteria in determining three general types of task manipulation found to have the strongest facilitative effects on class inclusion performance. These manipulations all have the effect of emphasising the superordinate class. The most consistently found effects have been due to the use of perceptual cues in the stimulus array. Specifically, the use of perceptually distinctive features to accent the entire superordinate class has been most beneficial in improving class inclusion performance (McGarrigle, Grieve and Hughes, 1978; Tatarsky, 1974; Wilkinson, 1976). The inclusion of items from extranous superordinate classes in the stimulus array has also had positive effects on performance (Trabasso *et al.*, 1978; Wohlwill, 1968). The most common error in class inclusion tasks is the direct comparison of the larger and smaller subordinate classes. Adding extraneous items theoretically makes this comparison more difficult and thus makes the superordinate class more salient. Modification of the linguistic structure of the class inclusion question is the third type of manipulation found to be effective generally in improving performance. Both Shipley (1979) and Hodkin (1981) reported a greater number of class inclusion responses when the word 'all' was used to modify the superordinate class. Winer's (1974) research on verbally elaborated questions lends further support to the importance of linguistic modification.

In addition to these types of task manipulation, class inclusion performance may also be affected by the specific superordinate classes used. Inhelder and Piaget (1964) found that children had a much more difficult time when 'animals' was the superordinate class than when 'flowers' was used. Brown (1958) hypothesised that children learn to label objects which make up classes such as 'animals' in a different manner from the way in which they learn to label objects which belong to classes such as 'flowers'. Labels learned for the 'animals' category are usually subordinate class labels like 'dog' and 'cat' whereas the label learned for objects in the 'flowers' category is invariable 'flowers', the superordinate class label itself. Brown argued that the child learns more specific (subordinate class) labels for objects which the adult expects her to distinguish but she learns the general (superordinate class) labels for objects which she is not expected to distinguish. Thus the specificity or generality of object labels acquired by the child is a function of the discriminatory abilities expected of her by adults. Markman's research (Markman, 1973; Markman and Siebert, 1976) adds support to the notion of differences is superordinate label salience. She found that when a collective noun like 'family' was used for the superordinate class, class inclusion performance improved significantly. Support for the importance of class content *within* the superordinate class was found by Carson and Abrahamson (1976). Improved class inclusion performance resulted when both subordinate classes contained typical exemplars than when either contained atypical exemplars. For the purposes of the present study,

then, it was concluded that manipulation of class content was a fourth general type of task feature affecting class inclusion performance. It was hypothesised that such performance would be significantly affected by the salience of the superordinate class label relative to the salience of the labels of its subordinate classes.

METHOD

Subjects

The participants were 128 boys and girls between the ages of six and eight years ($\bar{X}$ = 7.0) who were enrolled in one of two summer recreation programmes for youth in a metropolitan area. They were from predominantly middle-class families of various ethnic origins.

Materials

There were nine sets of stimuli. Each set consisted of five 4″ x 4″ line drawings of exemplars of a particular superordinate class. Three cards in each set showed identical drawings of an exemplar of one subordinate class and the other two cards showed identical drawings of an exemplar of another subordinate class. (See Figure 1 for an example set.)

Based partly on the work of Brandt (1980), four of the sets of drawings represented superordinate classes with labels of relatively low salience (animals, clothes, furniture, tools); four sets represented superordinate classes with labels of relatively high salience (birds, bugs, fish, and flowers); and the final set (fruit) was constructed specifically for use in the extraneous superordinate class conditions. Each set of five cards also contained a distinctive pictorial feature which was common to that entire superordinate class (e.g. all the flowers were in *vases*).

A listing of the nine sets of stimuli, the larger and smaller subordinate classes, and the pictorial cue common to each superordinate class is given in Table 1.

Table 1
Description of Stimulus Sets

Superordinate Class Label	Larger and Smaller Subordinate Classes	Common Superordinate Cue
High Salience		
birds	eagles and parrots	'on branches'
bugs	bees and butterflies	'by the flower'
flowers	roses and sunflowers	'in vases'
fish	sharks and whales	'in the water'
Low Salience		
animals	dogs and cats	'eating'
clothes	shirts and pants	'with stripes'
furniture	chairs and tables	'on the rug'
tools	hammers and saws	'in boxes'
Extraneous Class		
fruit	apples and oranges	

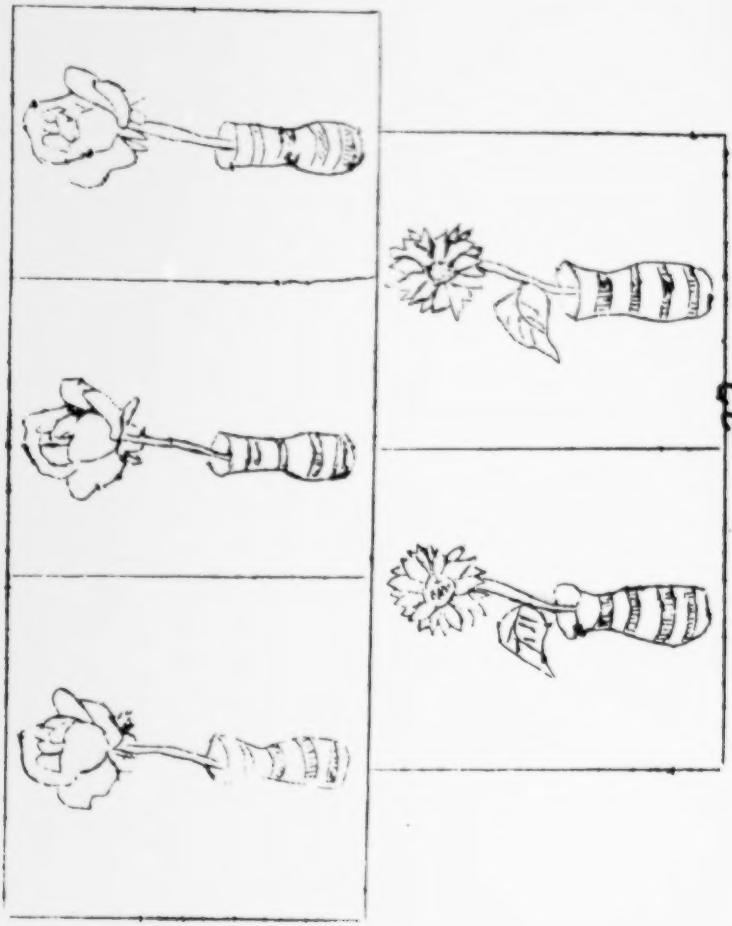

Figure 1: Example Stimulus Set

Procedure

All testing was done individually at the youth centres by one of the two experimenters. Using two rows of poker chips, one red and one white, all children were first screened for their ability to count and understand the terms 'more' and 'less'. Eight children were then randomly assigned to each of the sixteen conditions created by systematically varying the four factors mentioned above in 2 x 2 x 2 x 2 experimental design. Thus the experimental conditions were defined by: (1) whether or not reference was made to the common superordinate cue in the class inclusion question (2) whether or not the entire superordinate class was emphasised by preceding it with 'all of the ...' in the class inclusion question (3) whether or not an extraneous superordinate class was included in the stimulus array; and (4) whether the superordinate classes had relatively high or relatively low label salience.

In each of the eight experimental conditions with only a single superordinate class in the stimulus array, the child was presented with the five line drawings of each set linearly arranged along two rows, the three identical drawings from the smaller subordinate class (as in Figure 1). The child was then asked the following questions:

(1) 'What do we call these?' (pointing to the subordinate class members, separately for each subordinate class);
(2) 'What do we call *all* of these together?' (pointing to all of the members of the superordinate class);
(3) 'Are there more (label of larger subordinate class) or more (label of the superordinate class)?'

The exact format of the third question, the question of class inclusion, was determined by the experimental condition. Using the stimuli of Figure 1 as an example, the four possible question formats were:

(1) 'Are there more roses or more flowers'? (no reference to the common superordinate cue and no inclusive verbal emphasis);
(2) 'Are there more roses or more flowers in vases?' (reference to the common superordinate cue only);
(3) 'Are there more roses or more of all the flowers?' (inclusive verbal emphasis only);
(4) 'Are there more roses or more of all the flowers in vases?' (reference to the common superordinate cue and inclusive verbal emphasis).

In each of the eight experimental conditions that included an extraneous superordinate class ('fruit') in the stimulus array, the child was presented with five exemplars of the extraneous class (three identical drawings of an apple and two identical drawings of an orange), arranged linearly along two rows and above the exemplars of the target superordinate class. In these conditions, the child was asked the following questions:

(1) 'What do we call these?' (pointing to the subordinate class members, separately for each subordinate class in the extraneous superordinate class);
(2) 'What do we call *all* of these together?' (pointing to all of the members of the extraneous superordinate class);
(3) 'What do we call these?' (pointing to the subordinate class members, separately for each subordinate class in the target superordinate class);
(4) 'What do we call *all* of these together?' (pointing to all of the members of the target superordinate class);
(5) 'Are there more (label of the larger subordinate class in the target superordinate class) or more fruits?'
(6) 'Are there more (label of the larger subordinate class in the target superordinate class) or more (label of the target superordinate class)?'

Again, the exact format of the final question, that of class inclusion, depended upon the experimental condition.

To control for possible effects of presentation order, the four different stimuli sets in both the high and the low label salience conditions were presented in four different random sequences. Since four stimuli sets were presented in each experimental condition, the maximum score for a child was four.

RESULTS

Preliminary analyses revealed no significant differences in total class inclusion score between children at the two sample sites, between children tested by the two experimenters, or between boys and girls. Consequently, the data were pooled across sample sites, experimenters, and sex for *all* further analyses.

A four-way fixed ANOVA indicated that reference to the common superordinate cue was of borderline significance in producing higher class inclusion scores, $F(1, 112) = 3.37$, $P < .07$. A significant interaction was found between reference to the common cue and inclusive verbal emphasis, $F(1, 112) = 9.35$, $P < .01$. Using Turkey's multiple comparison procedure, it was found that children given reference to the common cue or given inclusive verbal emphasis did significantly better than children who were given neither. An interaction of borderline significance was also found between references to the common cue and salience of superordinate class label, $F(1, 112) = 3.72$, $P < 0.6$. Turkey's test indicated that, among children working with superordinate classes with low label salience, reference to the common superordinate cue led to significantly higher performance. No other effects were statistically significant.

The failure to clearly replicate any of the four general effects in the present study must be considered in light of its design. Since 11 of the 16

experimental groups included more than one task manipulation, a clearer understanding might result from an analysis of the experimental groups receiving no or only one manipulation. The performance of children who received only reference to the common cue ($\bar{X}$ = 3.25) or inclusive verbal emphasis ($\bar{X}$ = 2.38) was much higher than that of children who received only the stimuli with relatively salient superordinate labels ($\bar{X}$ = 1.13), Stimuli involving an extraneous superordinate class ($\bar{X}$ = 1.00), or stimuli involving none of the four task manipulations ($\bar{X}$ = 1.00). This difference between the former two groups ($\bar{X}$ = 2.82; s = 1.76) and the latter three groups ($\bar{X}$ = 1.04; s = 1.76) was statistically significant, t (38) = 3.13, $P < .01$.

In addition to the above analyses, an additional sample of 40 children of the same age range drawn from one of the youth centres to test more fully the effects of superordinate label salience. Though the children given superordinate classes with high label salience performed somewhat higher than those given classes with low label salience, this difference failed to reach statistical significance, t (38) = 1.38, $.05 < P < .10$, one-tailed test. Finally, the responses of the original sample of 128 children were combined and analysed in order to see if there were significant differences in class inclusion performance between specific stimulus sets. Percentage of correct responses made to each stimulus set of high and low label salience is indicated in Table 2.

Table 2
Percentage of Correct Class Inclusion Responses for Each Superordinate Class

Superordinate Class Label	Salience	Percentage
flowers	high	65
fish	high	63
bugs	high	61
birds	high	60
tools	low	55
clothes	low	55
furniture	low	53
animals	low	51

Note. N = 168.

All stimulus sets having high salience superordinate labels were associated with higher performance than any low salience stimulus set. The highest percentage of correct responses was made to the 'flowers' class (65%) and the lowest to the 'animals' class (51%). This difference in percentages was statistically significant, z = 1.82, $P < .04$, one-tailed test.

DISCUSSION

In a sense, this study could be seen as an attempt to maximise the child's demonstration of class inclusion performance. By combining task factors which previously had been shown to be most facilitative of performance, it was anticipated that *additive* interactive effects would be found. Clearly, this was not the case. Both of the significant two-way interactions were attributable to the lower performance of children receiving *neither* task manipulation. Children receiving both manipulations performed no better than children receiving only one of them. This lack of additive effect is in direct contrast to McGarrigle's *et al.* (1978) suggestion that *both* linguistic and perceptual cues are necessary to facilitate class inclusion performance.

Results comparing the relative effectiveness of single task manipulations were more congruent with expectations. As in previous research, referencing a common superordinate cue or adding an inclusive verbal cue in the class inclusion question were effective task manipulations. Although salience of superordinate class label and inclusion of an extraneous superordinate class had little or no effect on class inclusion scores, methodological considerations leave room for doubt about the effectiveness of these two manipulations. For example, to insure that children had clear referents for the classes mentioned in the inclusion question, subordinate classes were selected on the basis of what the children could easily identify. As a result, the selected subordinate classes may have had much more salient labels than more representative subordinate classes of the same superordinate class. If so, any effect due to differences in the relative salience of the label of their superordinate class may have inadvertently been balanced out. Consider the choice of 'bees' and 'butterflies' as subordinate classes of the superordinate class 'bugs'. Unlike most other insects, bees are far more likely to be identified by their subordinate label ('bees') than by the label 'bugs'.

With respect to the extraneous class conditions, the procedure of the present study included only one comparison question across superordinate classes, a comparison of the larger subordinate class of the target superordinate class with the entire extraneous superordinate class. Trabasso *et al.* (1978), asked all fifteen possible questions comparing the two superordinate and four subordinate classes. It may be that the greater number and variety of questions in the latter procedure makes the intent of the critical class inclusion question clearer to the child.

Perhaps it is time to take a more general view of class inclusion research to date. Two general conclusions seem to stand out. First, task factors which are logically unrelated to class inclusion competence clearly can prevent successful demonstration of that competence. This conclusion has validity well beyond the area of class inclusion. For example, Carmi (1980) argued that seemingly extraneous task factors and other contextual cues have a strong influence on the child's responses generally. Likewise,

Gelman (1978) has carefully documented inaccuracies that result from estimating the competence of young children from their performance on Piagetian tasks. Though this point is not new, researchers in some areas (e.g. Hirata, 1982 in the area of spatial perspective-taking) are beginning to summarise the demand characteristics of the tasks they use to assess competence. Though the degree to which specific contextual and procedural task manipulations are differentially important for specific types of performance tasks (e.g. cognitive, perceptual, or social) is not clear at the present time, there may be enough commonality in tasks typically used to assess young children's competence to attempt the development of a taxonomy of manipulative contextual cues operative in such tasks. This might allow more accurate assessment of underlying competence while adding to our knowledge of how children actually represent and process demands of the environment. Types of perceptual grouping within the task factors appear to have generality across many measurement situations.

One additional point needs to be made before leaving the issue of competence. While it is much more likely that one will make the error of not inferring competence when it is in fact present, it is of course possible to infer competence when it not there. When common perceptual cues are made extremely strong as in the common cue conditions of the present study, it is difficult to rule out the possibility that children are counting and comparing the larger subordinate class and the common superordinate cue itself (e.g. counting and comparing the number of roses with the number of *vases*). Thus the child might have given a correct answer on the basis of n exclusive-class comparison.

The second general conclusion to be drawn from class inclusion research to date is that as important as contextual cues are, there are real limits to the amount of variation in performance that can be explained using only such logically unrelated task factors. Clearly, *some* logical competence must also be involved. The intent of much of the research in this area seems to have been to show that Piaget seriously underestimated children's class inclusion skills. However, that point has been made repeatedly and well, and further research with this focus is likely to yield diminishing returns. Because of the central place they hold in the child's developing constellation of classification abilities, the understanding of class inclusion skills is important as an end in itself. Consequently, rather than simply assessing whether a child does or does not possess class inclusion abilities, future research might systematically examine specific processes underlying successful class inclusion performance.

Elaborating and integrating the component processes identified by Trabasso *et al.* (1978) might be a useful starting place. For example, many studies have shown the importance of emphasising the superordinate class, often by manipulating the child's attention to particular features of the perceptual display. It might be useful to re-evaluate the research in light

of two of the component processes identified by Trabasso *et al.* which are representing the physical display and finding a reference for the superordinate class. One possible line of research suggested by this reconceptualisation is investigation of the role of selective attention on the accurate representation of the perceptual display. For example, the conditions under which the superordinate-subordinate relationship is accurately encoded might be investigated by systematically varying the perceptual distinctiveness of the larger and smaller subordinate classes. Or in a training task, specific perceptual cues emphasising the superordinate class could gradually be removed from or added to the stimulus array and the corresponding effect on class inclusion performance determined. It would also be interesting to relate differences between children in the degree to which they are able to apply the concept of class inclusion to a range of situations and the encoding of particular kinds of perceptual or verbal cues.

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The Application of the Culture-Fair Tests as Measures of the General Mental Ability of Thai Adolescents**

Chumporn Yongkittikal

There has been an increasing demand in Thailand for the assessment of human general intelligence. There is, therefore, the need to search for an appropriate instrument to measure this ability. However, Thai psychologists are still using intelligence tests developed by psychologists in the West for Western subjects. Although some adaptations have been carried out, most of the normative studies are directed towards specific groups such as emotionally disturbed persons and students in specific educational institutions or regions.

Intelligences tests which, purportedly are culture-fair, are popular in Thailand. The purpose of this study is to investigate the potentials of three of these culture-fair intelligence tests as measures of general mental ability of Thai adolescents. The intelligence tests selected are Raven's Standard Progressive Matrices (SPM), Cattell's Culture Fair Intelligence Scale 3, Form B (CFIT) and Dominoes 48 Tests (D48). The four major specific goals of this study are to:

(1) investigate the development properties of the tests;
(2) examine item statistics of the tests;
(3) assess the reliability and validity of the tests; and
(4) establish norms of the test scores for Thai adolescents.

The subjects consists of 3,569 students of both sexes from 16 government and private schools in the Northern, Southern and Northeastern provinces and the Central Region. Their ages range from 12 to 18 years and the respondents are in grades 7 to 12.

The instructions of the tests were translated into Thai by the author. The SPM and D48 test were administered to all the subjects in their regular classrooms by 10 graduate students in psychology who have been trained for the tasks. CFIT is given to some subjects.

Difficulty indexes are in the direction predicted, thus giving evidences of the validity of the tests. Concurrent validity is estimated by calculating correlation coefficients among these three tests. The medians were .61, .65 and .60 for the SPM, CFIT and D48 tests respectively, thereby showing a certain degree of relatedness between them.

Using KR-20 to establish the reliabilities of these tests, the reliability coefficients of SPM cluster around the .90's; for CFIT, the reliabilities range from .63 to .78; and D48 test has reliabilities ranging from .89 to .91. It is concluded that these tests have internal consistencies.

The means of the test scores show that they increase with increasing age levels: the average scores of the SPM increase from 13 to 16 years while those of CFIT and D48 test increase from ages 13 to 15 years.

The correlation between each intelligence test and grade-point-average (academic achievement in Thai language, English, Mathematics and Social Studies at the end of the academic year) is computed for each age level. The correlations vary markedly, ranging from .06 to .70. The findings suggest that these tests are not effective predictors of academic achievement.

Comparisons of the data with British and American norms indicate that Thai adolescents are above the British norms for the SPM at the corresponding age levels except for the 13 year olds; norms of the Thai adolescents are also above the American norms for CFIT, Scale B. However, it must be noted that the British and American norms were established for adolescents of 15 years ago.